REMARKS

New independent claim 14 is the combination of claims 9, 10, 11, 12 and 13, and further requires that one or both of the lower electrode and the upper electrode predominantly contains Pt. Support for claims 14, 20 and 21 is found, for example, at page 4, lines 7-18 of the specification.

Claims 15-20 correspond to claims 3-8, respectively. Claims 2-13 have been canceled in favor of new claims 14-21.

Entry of the amendments and review and reconsideration on the merits are requested.

New independent claim 14 defines a novel and unobvious combination of features which forms a humidity sensor. Included among the features of this humidity sensor is a lower electrode comprising a noble metal porous body, a porous moisture sensitive layer and an upper electrode comprising a noble metal porous body successively formed on an insulating substrate, wherein the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate. The size of pores in the upper electrode is 0.5-20 μm, the size of pores in the lower electrode is 0.5-20 μm, the size of pores in the moisture sensitive layer is 0.05-0.2 μm, particles of ceramic are incorporated in an amount of 1-20 weight % into the upper electrode, and particles of ceramic are incorporated in an amount of 1-20 weight % into the lower electrode. Moreover, one or both of the lower electrode and the upper electrode predominantly contains Pt. As claimed in claims 20 and 21, one or both of the lower electrode and the upper electrode predominantly contains Pt and further contains Rh.

As discussed at page 4 of the specification, the combination of Pt and Rh is especially useful, because evaporation of Pt at high temperature is suppressed. Moreover, either or both of the electrodes predominantly contains Pt. This is because Pt does not usually oxidize at high temperature, does not diffuse in the moisture sensitive layer, and has a sufficiently high melting point. Therefore, when the lower and upper electrodes are formed from Pt, the humidity sensor exhibits further enhanced durability.

Turning to the cited prior art, claims 2 to 7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 4,379,406 to Bennewitz et al in view of U.S. Patent 5,792,938 to Gokhfeld.

Claim 8 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al in view of U.S. Patent 4,608,232 to Sunano et al. Sunano et al was cited as disclosing a gas sensor adapted for measuring humidity in an atmosphere containing a reducing gas.

In response, claims 2-8 have been canceled, and withdrawal of the foregoing rejections is respectfully requested.

Claims 9 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al in view of U.S. Patent 4,602,426 to Kampe et al. Kampe et al was cited as disclosing a porous gas diffusion electrode having a pore size within the range of 0.5-20 μm as claimed. The reason for rejection was that it would have been obvious to employ the electrodes of Kampe et al in the sensor of Bennewitz et al so as to allow moisture to penetrate from the upper and lower electrodes.

claim 11 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bennewitz et al in view of U.S. Patent 4,656,455 to Tanino et al. The Examiner relied on Tanino et al as disclosing a humidity-sensing element including a moisture sensitive layer having a pore size within the scope of rejected claim 11. The reason for rejection was that it would have been obvious to incorporate the porous moisture sensitive layer of Tanino et al in the sensor of Bennewitz et al, "to keep particulates from the atmosphere from depositing onto the humidity-sensing parts".

Applicants respectfully traverse for the following reasons.

As required by independent claim 14, "the upper electrode is joined to the moisture sensitive layer and a portion of the insulating substrate". In this manner, the present invention provides a humidity sensor exhibiting enhanced durability, and which can maintain excellent humidity detection performance over a long period of time. Particularly, this is the case even when the sensor is exposed to an atmosphere which undergoes a drastic change in temperature and contains a very small amount of oxygen and a considerable amount of a reducing gas, such as the atmosphere in an exhaust pipe of an automobile; or even when the sensor is provided, for example, in a fuel or air feeding line of a fuel cell. See page 3, lines 3-13 of the specification.

As shown in Fig. 1(b) of the specification, a portion 14a of upper electrode 14 is joined to moisture sensitive layer 13, and a portion 14b of upper electrode 14 is joined to a portion of insulating substrate 11 (see page 12, lines 1-10 of the specification).

In each of the above rejections, the Examiner relied on Bennewitz et al as disclosing the humidity sensor substantially as claimed.

Turning to the cited prior art, in the humidity sensor of Bennewitz et al as shown in Figs. 1 and 2, upper electrode 28 is formed on moisture sensitive layer 24 and substrate 12 via chrome bonding layer 26. See also col. 5, lines 60-68 of Bennewitz et al.

As such, Bennewitz et al does not meet the terms of present claim 14, and the Examiner has not set forth any reason as to why one of ordinary skill would be motivated to modify the upper electrode 28 of Bennewitz et al such that it is joined to both the moisture sensitive layer 24 and the substrate 12.

Gokhfeld does not cure the deficiencies of Bennewitz et al, where electrode 3a contacting humidity sensing layer 3 is not joined to substrate 2.

Like Bennewitz et al, Sunano et al also fails to disclose, in laminate structure, an upper electrode joined to both the moisture sensitive layer and a portion of the insulating substrate as required by independent claim 14. Particularly, in Sunano et al, electrodes 2 and oxide film 3 (oxygen sensitive film) are provided directly on substrate 1. There is no laminate structure of a lower electrode, a moisture sensitive layer and an upper electrode successively formed on an insulating substrate as required by present claim 14.[1]

Kampe et al likewise fails to remedy the deficiencies of Bennewitz et al. Particularly, Kampe et al does not disclose a humidity sensor including an upper electrode joined to both a moisture sensitive layer and an insulating substrate as required by the rejected claims. Therefore,

[1] In Sunano et al, electrode 2 is joined to both substrate 1 and oxide film 3 (but not in the form of a laminate).

there is no combination of Bennewitz et al and Kampe et al which could result in the present invention.

With respect to the rejection over Bennewitz et al in view of Tanino et al, the passage cited by the Examiner (col. 3, line 28) refers to the pore size of filter film 10 (col. 6, lines 54-65), and has nothing to do with the porosity or pore size of humidity-sensing part 4. Additionally, Tanino et al does not disclose or otherwise illustrate an upper electrode joined to both a moisture sensitive layer and an insulating substrate as required by claim 14, and therefore does not remedy the deficiencies of Bennewitz et al.

Although Möbius et al surely discloses electrodes containing ceramic particles, Möbius et a fails to disclose an upper electrode of a humidity sensor joined to both a moisture sensitive layer and an insulating substrate, and therefore also fails to cure the deficiencies of Bennewitz et al. Thus, the resulting combination could never achieve the present invention.

Applicants further point out the following difference between the invention and the prior art as follows.

Claims 20 and 21 require that at least one or both of the lower electrode and upper electrode predominantly contains Pt and further contains Rh.

Bennewitz et al discloses that lower electrode 22 is formed of five nines pure gold or other noble metal (column 5, lines 49-50), and that upper electrode 28 is formed of five nines pure gold or other suitable electrode material such as nickel, indium, or a noble metal (column 5, lines 65-67). However, Bennewitz et al does not disclose a lower electrode or upper electrode predominantly containing Pt and further containing Rh.

Kampe et al is concerned with a gas diffusion electrode, and has nothing to do with a humidity sensor.

As shown in Fig. 1, Tanino et al discloses a pair of comb-like gold electrodes 3 (column 4, lines 13-27), entirely different from the lower and/or upper electrode predominantly containing Pt and further containing Rh as claimed in claims 20 and 21.

Möbius et al relating to a fuel cell, also fails to disclose lower and/or upper electrodes predominantly containing Pt and further containing Rh. The ceramic oxide electrode layers of Möbius et al are entirely different from those of the claimed invention.

For completeness, Gokhfeld does not disclose the composition of electrode contacts 3a, 3b (column 7, lines 21-24). Furthermore, whereas Sunano et al discloses printed platinum electrodes 2 (column 6, lines 27) and printed platinum electrodes 20-23 (column 8, lines 19-20), Sunano et al does not disclose lower and/or upper electrodes predominantly containing Pt and further containing Rh as required by present claims 20 and 21.

For the above reasons, it is respectfully submitted that the claims presented herein are patentable over the cited prior art, and withdrawal of the foregoing rejections is respectfully requested.

Withdrawal of all rejections and allowance of claims 14-21 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

Respectfully submitted,

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